TECHNICAL MEMORANDUMS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

No. 297

ROYAL AERO CLUB LIGHT AEROPLANE COMPETITION.

By J. S. Buchanan.

Paper read before the Royal Aeronautical Society, October 30, 1924.

January, 1925.

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By J. S. Buchanan.

I am indebted to the Air Ministry for permission to use the material contained in the various official reports dealing with this subject, and I wish to say that the views expressed in this paper are my own personal views and do not in any way represent the official view of the Air Ministry, nor indicate the policy to be pursued.

I am also indebted to the makers of the aircraft for supplying information in such detail and for permission to make use of this information.

In dealing with a paper of this description, it is appropriate that some reference should be made to the origin of the light aeroplane, and for this reason I have begun with a short outline of the inception and development of a type of aircraft which may have an important effect on the future of aviation.

The success achieved in Germany in gliding with aeroplanes without a power unit during the years 1921-22 aroused great interest in this country and led to extravagant statements being made as to the future of this type of aviation.

The "Daily Mail" offered a considerable prize for a competition between aircraft of this type, and trials were carried out, under the control of the Royal Aero Club, at Itford, in September, 1922.

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A considerable measure of success was achieved in gliding on the ridge at parts where the up-currents of air provided the power required to overcome the force of gravity. As is well known, the prize was won by M. Maneyrol on a Peyret glider.

Immediately following these tests, about October, 1922, Mr. Manning of the English Electric Company put forward to the Air Ministry a proposal to construct a small aeroplane fitted with a $3\frac{1}{2}$ HP A.B.C. engine. A contract was made, and one aeroplane was designed and built by this firm. This was flown successfully by Squadron Leader Wright in April, 1923. While it was clear from consideration of the aerodynamics of the design that an aeroplane of this type would fly satisfactorily, it was considered doubtful if there would be sufficient power to get off the ground without external aid. Arrangements were made for catapulting if this fear proved well founded. As events turned out, the initial flights showed that there was sufficient power available to enable the aeroplane to take off even in a calm.

About December, 1922, Major Gnosspelius and Mr. Lancaster-Parker commenced the design of the Gull aeroplane, which was fitted with a 750 cc Blackburn engine. This type was novel in its design, and followed the lines indicated by the model tests carried out by the designer at Rochester, using the pendulum method.

Early in 1923, the Duke of Sutherland, then Under-Secretary of State for Air, offered a prize of £500 for a competition between light aeroplanes, as they had now come to be called, to be held to-

ward the end of 1923, with engines not exceeding 750 cc capacity.

The "Daily Mail" again came forward and offered £1000 for the same purpose. The conduct of the competition was undertaken by the Royal Aero Club. Further prizes were subsequently offered for reliability, altitude and speed tests.

The view held by even the most competent technical opinion on the possibilities of this type of aircraft is indicated by the great care which was taken to select a suitable site for this competition. Finally, Lympne Aerodrome was selected, and the selection was certainly influenced by the presence of a ridge of hills near the aerodrome which would facilitate gliding on up-currents and assist flight. No doubt competitors obtained considerable assistance from such currents.

The competition was held in October, 1923. An extract of the conditions of the tests is given in Appendix I.

Table I gives a list of the aeroplanes which appeared at Lympne for these competitions and gives their general aerodynamic characteristic as well as the performance measured during the tests. Table II is a summary of the detail weights of each type of aircraft, so far as I have been able to obtain these in the time at my disposal. I have endeavored to make these as accurate as possible, but it is always a matter of great difficulty to get such figures reduced to a truly comparative basis. They are about as accurate as any other comparative weight schedule..

The engines used were motor-bicycle engines not designed for aircraft use, and while many detailed troubles were experienced, the

engines, on the whole, ran very well.

In general, the most reliable power units were those in which the propeller was driven directly off the crankshaft. In those cases where a chain drive was used, the drive gave considerable trouble, and prevented any reasonable comparison being made of the relative efficiency of geared and ungeared drives for the propeller.

The Sargant engine, fitted to the Peyret and the Poncelet monoplanes, had a $2\frac{1}{2} : 1$ helical spur gear drive to the propeller, but the amount of flying done by this engine was insufficient to furnish a real test of its relative efficiency.

The loading per HP varied from 17.7 to 60, but the majority of the types were in the neighborhood of 30-35 lb. per HP; these figures are approximate only, since the available information with regard to engine power and R.P.M. actually used was scanty. Generally speaking, it might be said that the HP loading of 30-35 lb. per HP gave sufficient power for reasonable flight with the wing loading employed.

From the number and character of the forced landings which took place during this competition it would appear that lighter-loaded types - that is, types with a wing loading of about 4 lb. per sq.ft. - could make a forced landing in a restricted area at least as easily as aeroplanes with a larger reserve of power.

Of the fifteen aircraft flown, only three were biplanes, and these were seriously handicapped by engine trouble during the whole week. For this reason it is difficult to estimate the comparative merits of monoplanes with biplanes in the air for this class

of aircraft. Both types were quite satisfactory in the air.

From a constructional point of view the majority of the aircraft had been carefully designed, and while it is true that the scantlings of the parts were rather fine, no trouble in this direction was revealed during the week's flying. At the same time, it must be admitted that in the majority of cases the size of the members was unsuitable for any sort of rough handling.

As regards the wings, the great range of aerofoil sections used showed that there was a considerable divergence of opinion on the best type of aerofoil for this type of aircraft. The figures available from the tests do not show that any particular type of aerofoil was markedly superior to any other. Various wing arrangements were employed and various methods of spar construction, but there was no radical departure from what is considered standard practice.

Three-ply was largely used in the construction of fuselages, even in some cases to the extent of using three-ply gusset plates in place of the usual metal fittings.

On the whole, the landing gears could not be considered satisfactory, with the exception of the D.H.53 "Viget" and possibly the Parnall "Pixie." The undercarriage of the "Pixie" was of a novel type, and depended for its shock-absorbing capacity on the resilience of the axle and the tubular struts. Experience over this past year has shown that this type of undercarriage gives reasonable service. It was apparent that small wheels inside the fuselage were not suitable for general work, particularly as it involved a

small angle on the ground, and therefore a long run to get off and land, as well as rendering the fuselage liable to accidental damage. On some machines larger wheels were fitted, and these in general were the more satisfactory.

With regard to the control surfaces, it was to be expected that these would be proportionately larger than those in common use on ordinary aircraft, bearing in mind the slow flying speeds of these light aeroplanes, and the experience at Itford on gliders the preceding year.

Some of the aeroplanes taking part in this trial were purchased by the Air Ministry. So far only three of these have been tested at Martlesham, and the results of these tests are given in brackets in Table I. Further types are still to be delivered.

In addition to this, six of the D.H.53 type were purchased and sent to various R.A.F. units for general test. These have been flown by a large number of R.A.F. officers and are standing up to ordinary service use in a satisfactory manner. The 750 cc "Blackburn" is fitted to these aeroplanes.

It is difficult to assess the results of this competition. It can be said at once that there was nothing in any of the aeroplanes which could be called new, either structurally or aerodynamically. On the other hand, the aeroplanes exceeded expectations in performance, as will be seen from the figures in Table I. They got off the ground easily and flew comfortably at 30-35 lb. per HP, and in one case at 60 lb. per HP. In my opinion these results can be attribut-

ed only to clean design and to the greatest care of the details of construction. The aerodynamic efficiencies of these aircraft are high, and I regret that sufficient test information is not yet available to give exact figures on this point. One of the types tested (the Gull) has an efficiency KL/KD of about 14 to 1, and it is possible that some of the others may have higher efficiencies. This compares very favorably with the efficiencies KL/Kd of military and civil types which are of the order of 5/1 to 8/1.

One factor which may contribute to this improved efficiency is that the engine exerts very much less influence on the design than is the case with what we may call normal aircraft. You will see from Table II that the power unit percentage is small, but further than that the engine is of such a size as to fit easily into any fuselage capable of accommodating a man. For this reason, as well as the absence of extraneous equipment, a clean fuselage line is possible.

At the close of the tests the Under-Secretary of State for Air announced that the Air Ministry would offer a substantial prize for a two-seater dual control aeroplane to be competed for in 1924. After some discussion, the size of the engine was fixed at a maximum value of 1100 cc volume swept. There was, and there still is, considerable divergence of opinion as to the size of engine required for this type of aeroplane, but it was felt that an engine of this size would give a satisfactory performance when fitted to an aeroplane for competition purposes.

It was considered that the experience of the 1923 tests had

shown that petrol consumption was relatively a small proportion of operational costs, and for this reason it was decided not to introduce a petrol consumption test in the next year's competition.

The main object of the new competition was to produce a dual control light aeroplane suitable for use by both official and unofficial bodies, and to ascertain to what extent the cost of flying could be reduced. The rules were therefore framed round the following features:

1. Speed range.
2. Distance to get off and land.
3. Reliability.

Each aeroplane, prior to the competition, was required to demonstrate that it was in fact a dual control aeroplane and could be flown from either seat. An extract of the conditions of the competition is attached as Appendix II.

The Royal Aero Club again consented to organize and carry out this competition, and Lympne Aerodrome was selected as the site.

The competition commenced on September 27, 1924. In all, nineteen entries were received and fifteen aeroplanes were presented to the judges at 10 a.m. on September 27. The aeroplanes had to pass the eliminating test, which included a dismantling and housing test, as well as a dual control test, before 6 p.m. on September 28, and the competition proper opened on September 29.

It was at once evident that the time allowed to the engine manufacturers to develop the engines had been insufficient, and

only eight out of the fifteen aeroplanes presented to the judges finally passed into the competition proper. A list of the entrants, together with their recorded performances, will be found in Table III.

Table II also gives such details as I have been able to collect of the component weights of the types.

The results of the tests again exceeded expectations.

The maximum recorded speed was 79 M.P.H. (Beardmore) and the minimum recorded speed was 37.22 M.P.H. (Parnall). The Beardmore had a speed range of approximately 2/1, which is a notable performance for the weight/HP ratio (26.8) of the aeroplane.

The length of run to take off and the length of run to pull up were distinctly good, and compare favorably with similar figures for normal aircraft of half the weight/HP ratio.

Table IV is a summary of the results of the tests carried out at Martlesham Heath as part of the competition for commercial aeroplanes in 1920. These figures call for little comment, and are reasonably comparable as the weather conditions were similar.

The general impression of pilots was that the performance and feel of the aeroplanes were satisfactory, but in all cases it was considered that more power was required to secure a better rate of climb.

This last competition, more than any other, demonstrated the safety of these light aeroplanes in a forced landing. Statistics for normal aircraft show that one forced landing in every four re-

sults in some damage to the aircraft. It has not been possible to give the number of forced landings which took place during the last trials, but in only one case was any damage done to the aeroplane. My own estimate of the number of forced landings is between forty and fifty. The facility with which the light aeroplanes could get into a field and get off from the same field again was quite remarkable.

Turning to the structural design of the aircraft, the general remarks made earlier in this paper on the structure of the 1923 light aeroplanes apply equally to the aeroplanes of 1924 with some notable exceptions. The undercarriages fitted to most aeroplanes were distinctly superior to those fitted on the single-seater types. The get-off and landing tests, I do not doubt, were responsible for this. The "Satalite" and "Avis" are fitted with a form of Oleo undercarriage and the results obtained from these were entirely satisfactory. The Westland was fitted with an undercarriage with a steel spring return and a ferrodo lined tube to absorb energy. The Bristol Company entered one aeroplane with a complete all-metal structure. The production of an aeroplane of this size in metal is a distinct achievement, and it is of interest to note that this aeroplane won the second Air Ministry as well as the Duke of Sutherland's prize. How far it will be possible to produce such a structure on a commercial basis is a matter of conjecture. My own personal view is that it would be a matter of extreme difficulty to produce such an aeroplane at a reasonable price.

It is of interest to note that nine biplanes were presented to the judges as against six monoplanes, showing that designers in this country as a whole consider that for all-round suitability - that is, for performance and robustness in handling - the biplane is the superior type.

It is difficult from the results of the competition to sort out the relative aerodynamic efficiencies and performances of the two types. Monoplanes won the principal prizes. The reliability prize and the second prize for taking off and landing were won by biplanes, so that so far as actual prizes were concerned the monoplanes were easily first. The actual results, however, were so much affected by engine difficulties that the above comparison is of very little technical value and is distinctly unfair to the biplane. Many of the aeroplanes were unable to finish the ten laps of the speed test, and for that reason were awarded no marks for speed range. All of them, however, were able to finish one lap of the high-speed course (the figures are given in Table III), and if this measurement is taken as a basis of working, there is a considerable difference in the relative positions. The Beardmore monoplane is still first. Immediately behind is the Hawker biplane (A.B.C.). The third is the Bristol monoplane, and following that the Hawker biplane (Anzani), followed again by the Parnall biplane. Even these, however, are not entirely rid of engine trouble, as it is known that some of these aeroplanes could have done better in their relative performances if the engines had not given trouble. It does indicate, however, that for the pur-

poses of the competition there is little to choose between the best monoplane and the best biplane, with the balance in favor of the monoplane.

The tests were carried out in very fortunate weather. The taking off, landing and slow-speed tests were carried out in weather conditions which amounted to a flat calm for all practical purposes.

I attach a table (Table V) showing the wind readings taken during the week in the middle of the aerodrome about 8 feet from the ground, and better conditions than these are rarely found in this country.

The competition was of considerable interest from an engine standpoint. As a result, it is possible to make a fair estimate of the power required for aircraft of this type. During the week a large number of engine failures were reported and a general impression was that engines were unsatisfactory, whereas closer investigation shows that they were, in fact, doing well under the circumstances and that many of the troubles experienced were due to overloading. From the type tests of the "Cherub" engine, the normal power should be 25.5 HP at 2500 revolutions, and the "Blackburn" 27 HP at 2700 R.P.M. In every case these speeds were exceeded, and the aeroplanes were flown in most cases with the engines giving more than the maximum permissible R.P.M. Under these conditions it is not astonishing that a large number of failures were experienced.

I think it is clear from the results of the competition that more power is required and that engine speeds should be kept down

if reliability is to be attained.

Once again the geared type of engine failed to keep in the air, and although the aerodynamic advantage of the geared type is certain, it would appear that considerations of engine design preclude its use. That is most regrettable, as it puts an important limit to engine speed and has the effect of increasing engine size still further.

Conclusions.

Having put on record the facts as they have been ascertained by this series of competitions, it is of considerable interest to review the position now, with a view to considering what steps are desirable for the future development of this type of aircraft.

The main object of these competitions was to make flying cheap and safe, and thus to popularize it to the extent of making it part of our national life.

You will observe that a start was made from the beginning with the glider and progressive tests have been carried out with the single-seater light aeroplane and the two-seater dual control type. From these experiments we have learned the HP necessary to give a reasonable performance for each of these types. In the case of the single-seater it is apparent that 15-18 HP is adequate for reasonable performance. In the case of the two-seater, it is clear that somewhere near 40 HP is required. Hitherto the aircraft designer has been dependent entirely on the engine designer, and aircraft design has progressed more by virtue of increased power than by increased

aerodynamic efficiency. In the light aeroplane this position is being reversed, and the aircraft designer has now put forward his best efforts in order to obtain a maximum aerodynamic efficiency with a minimum structure weight, consistent with strength and robustness, if the light aeroplane is ever to become a factor in aviation.

A glance at the table of weight schedules both for 1923 and 1924 shows that the structure weights of these aeroplanes are relatively high. The average figure appears to be 44 per cent for the single-seaters and 42 per cent for the two-seaters, as compared with a corresponding figure of about 32 per cent to 33 per cent for larger types of aircraft, with the same factor of safety. The figures for a Bristol Fighter are attached at the end of the table to give an approximate comparison.

It will be noticed also that the average load carried amounts to 37 per cent in the case of the single-seaters and 41 per cent in the case of the two-seaters of the total as against a figure of 25 per cent to 30 per cent for normal aircraft. Some of this difference is accounted for by the small amount of petrol carried by the light aeroplane. A further notable feature is the low value of the power unit weight. That again is affected by the quantity of petrol which is included in this item. It would appear, however, that there is some margin for improvement in the structure weight by the adoption of new methods of construction and new materials. Hitherto these aeroplanes have been designed on established methods and with standardized materials, and it is possible that a reconsideration of these

factors would lead to improvement. The figures for the Hawker aeroplanes indicate what can be done by painstaking design and close attention to details.

It is also clear that the aeroplanes as tested at these competitions were not cheap to build, but on the other hand no effort has been made to manufacture them, because there is no market in which to sell them. Unless both first costs and running costs are kept down, the market will be a restricted one.

The matter of petrol consumption must not be lost sight of. In the 1923 competition a consumption of 87 miles per gallon was attained. In the 1924 competition, so far as I can ascertain, the average consumption was of the order of 30 miles per gallon, and it is important that we do not, in our desire to provide plenty of power, increase this petrol consumption until it becomes, once again, an important factor in the operation of these light aeroplanes.

Although a great deal of work has been done during the past three years towards the solution of the problem of supplying the cheap and safe aeroplane, a great deal more has to be done, and every care should be exercised that in correcting the defects which have been discovered by these competitions we do not sacrifice the important assets which the aeroplanes already possess.

It will be seen that in all these tests and discussions the question of a small seaplane has not been considered. I would suggest that there is ample scope for such development in this country, where suitable waters are numerous and where a considerable proportion of

the youth of the country are interested in matters concerning the sea. A step up in engine size is inevitable for the small seaplane, but I believe that a suitable aircraft could be made with an 1100 cc engine.

I wish to apologize for my very rough analysis of the data. Owing to the short time available the paper had to be written while the data was being collected, and there was not time to make a close survey of the figures.

Appendix I.

Motor Glider Competition at Lympne Aerodrome, October 8-13, 1923.

Organization

The Competition will be conducted by the Royal Aero Club.

Motor Glider

The Competitions are open to any heavier-than-air machine with engine, the total piston displacement of which does not exceed 750 cc. The Royal Aero Club reserves to itself the right to check the piston displacement of any engine taking part in the Competitions. Any additional motive power produced by the personal exertions of the occupants during flight is allowed. The machine must not be supported either wholly or in part by any gas which is lighter than air.

Competitors may use any launching device provided by themselves.

Pilot.

The weight of the pilot must be made up to a minimum of 168 lb.

All pilots must be weighed prior to the start of the Competitions. Pilots under the minimum of 168 lb. must carry the additional weight necessary to make them up to this weight, and this will be checked before and after each flight.

Transport

Competitors must demonstrate to the Officials that the machine is capable of being transported on the ground a distance of one mile by not more than two persons without the use of any extraneous tackle within a period not exceeding three hours. The selected course for this test will include the getting out of a field through an ordinary gateway, 10 ft. wide, and proceeding along a 15 ft. road, occupying not more than half the width of the road.

Machines may be presented to the Officials for the Transport Test from 10 a.m. on Saturday, October 6, 1923.

Machines must be presented to the Officials fully erected.

Any time occupied in dismantling will be included in the three hours allowed for the Transport Test.

There is no restriction as to the number of persons engaged in any dismantling necessary for the Transport Test, but only two persons will be allowed for the purposes of Transport.

No special devices will be allowed for the Transport Test unless carried as part of the equipment of the machine in flight during the Competitions.

This test must be passed before any flight is made in any Competition.

Course

All flights will be made over a triangular course of approximately $12\frac{1}{2}$ miles, the exact location of which will be announced later.

The Turning Points will be marked by White Crosses on the ground, which each Competitor must pass on his left at a height of not more than 1000 feet, and at a sufficiently close range so that his number may be easily identified by the Official Observers.

The "Daily Mail" £1,000 Prize.

To be awarded to the Entrant of the machine which accomplishes the longest distance in one flight with one gallon of fuel, providing such flight is not less than fifty miles.

This Prize is open to all nationalities.

Fuel

The distance covered by the use of one gallon of fuel only will be reckoned. Competitors, however, will be required to finish each flight at Lympne Aerodrome by crossing the finishing line in flight. No flight will count if the landing occurs outside the Aerodrome.

In order to enable this to be done, Competitors will be served out with a measured quantity in excess of the one gallon as required by them. After the flight the amount remaining in the tank will be measured and the distance flown on the one gallon will be calculated pro rata, provided more than one gallon is consumed.

Competitors who consume less than one gallon will be treated as if they had consumed the whole of one gallon.

The Sutherland £500 Prize.

To be awarded to the Entrant of the machine which accomplishes the longest distance in one flight with one gallon of fuel, providing such flight is not less than fifty miles.

The Entrant and Pilot must be British subjects, and the machine and engine must have been entirely constructed in the British Empire.

Fuel

The distance covered by the use of one gallon of fuel only will be reckoned. Competitors, however, will be required to finish each flight at Lympne Aerodrome by crossing the finishing line in flight. No flight will count if the landing occurs outside the Aerodrome.

In order to enable this to be done, Competitors will be served out with a measured quantity in excess of the one gallon as required by them. After the flight, the amount remaining in the tank will be measured and the distance flown on the one gallon will be calculated pro rata, provided more than one gallon is consumed.

Competitors who consume less than one gallon will be treated as if they had consumed the whole of one gallon.

The Abdulla £500 Prize.

To be awarded to the Entrant of the machine which covers two circuits of the course (approximately 25 miles) in the fastest time.

This Prize is open to all nationalities.

The fuel allowance is not limited.

The starting and finishing line must be crossed in flight.

The Society of Motor Manufacturers and Traders £150 Prize, and the British Cycle and Motor Cycle Manufacturers' and Traders' Union £150 Prize.

To be awarded to the Entrant of the machine which flies the largest number of completed circuits of the course during the period of the Competitions, with a minimum of 400 miles. Circuits flown in the other Competitions will count towards these Prizes.

The Entrant and Pilot must be British subjects, and the machine and engine must have been entirely constructed in the British Empire.

The same machine and engine must be used throughout, and parts will be marked to ensure this, but special tanks will be permitted, the fuel allowance not being limited.

Appendix II.

Two-Seater Light Aeroplane Competitions, 1924.

(Under the Competition Rules of the Royal Aero Club)

Prizes

£3,000, presented by The Air Council.

500, presented by The Duke of Sutherland.

150, presented by The Society of Motor Manufacturers and Traders.

150, presented by The British Cycle and Motor Cycle Manufacturers' and Traders' Union.

100, presented by Captain C. B. Wilson, M.C.

Organization

The Competition will be conducted by the Royal Aero Club, under the Competition Rules of the Royal Aero Club.

Light Aeroplane

The Competition is open to any aeroplane, the total piston displacement of the power plant of which does not exceed 100 cc.

Two-Seater, Dual Control

The aeroplane must be a two-seater fitted with dual control, and an airspeed indicator must be visible from either seat.

British Manufacture

The aeroplane, including the engine and magneto, must have been designed and constructed in the British Empire.

Fuel

The ingredients of the fuels used must be commercially obtainable in bulk.

Competitors

The Entrant and Pilot must be British subjects.

Load to be Carried

The load to be carried, exclusive of fuel, must be made up to 340 lb. This includes the weight of the pilot and passenger (if carried). If there is no passenger, the balance of the total weight required must be carried in the spare seat.

The carrying of a passenger is optional, except in the Eliminating Test "B," Demonstration of Dual Control, in which case it is not permitted.

Eliminating Tests.

The Eliminating Tests will be as follows:-

(A) Dismantling, Housing and Re-erecting.- For this test the aeroplane must be presented to the Official fully erected.

It must then be dismantled or folded in such a manner as to permit of its being completely transported in one journey, without the use of any extraneous tackle, over a distance of not more than 25 yards, and placed in a shed 10 ft. in width. It must then be taken outside the shed and re-erected.

Two persons only will be allowed to handle the aeroplane throughout this test, and the time occupied must not exceed two hours.

No special devices will be allowed unless carried as part of the equipment of the aeroplane in flight during the Competitions.

(B) Demonstration of Dual Control.- This test will consist of two separate flights, each of one complete lap of the course, at the

termination of each of which one figure of eight must be flown within the boundary of the aerodrome.

The pilot must be alone and occupy alternately the two seats in the aeroplane.

Eliminating Tests "A" and "B" must be carried out in this order, and must be passed to the satisfaction of the officials before any flights are made in the competition proper.

Aeroplanes must be presented to the officials, fully erected, for the Eliminating Tests at 10 a.m. on Saturday, September 27, 1924. Aeroplanes not so presented will be debarred from taking part in the Competition.

The Eliminating Tests will commence at 10 a.m. on Saturday, September 27, 1924, and will be continued on the following day. These tests must be completed by 6 p.m. on September 28. Aeroplanes not having done so will be debarred from taking part in the Competition.

Competition.

In order to be eligible for any of the Prizes offered, competitors must complete at least ten hours' flying in the various tests during the period of the competitions.

Prizes

1st Prize, £2,000, presented by the Air Council.

2nd Prize, 1,000, presented by the Air Council.

The Prize of £2,000 will be awarded to the entrant of the aeroplane which shall have obtained the greatest aggregate of marks in

the Schedule of Tests.

The Prize of £1,000 will be awarded to the entrant of the aeroplane which is placed second.

Schedule of Tests

1. Range of Speed.
   (a) High Speed.
   (b) Low Speed.
2. Getting off.
3. Pulling up.

High Speed

This test will be carried out over a course, in two separate flights of approximately 75 miles each.

An interval will be allowed between the two flights for taking in fuel and oil only.

All flights will be made over a triangular course of approximately $12\frac{1}{2}$ miles.

The Turning Points will be marked by White Crosses on the ground, which each Competitor must pass on his left at a height of not more than 500 feet, and at a sufficiently close range so that his number may be easily identified by the Official Observers.

The same line will be used for starting and finishing. Competitors will be at liberty to take off from any point on the aerodrome, but will be timed from the first time they cross the starting line in flight, keeping the Aerodrome Turning Point on their left.

There is no restriction as to the number of attempts allowed in the High Speed Test provided such flights do not interfere with the

carrying out of the other tests.

Competitors must hand in written notice to the Official Office at least half an hour before each flight is made. Competitors not starting within fifteen minutes of the time stated in the notice may be required to put in a further notice.

Low Speed

The aeroplane will be timed up and down a straight course of not less than 500 yards.

The width of the course for the Low Speed Test will be 25 yards, and will be indicated by red flags placed at intervals on each side. The aeroplane will be considered as being on the course provided any part remains within the boundaries indicated by the red flags. No marks will be awarded if the aeroplane flies outside the limits of the course.

The course must be covered twice in each direction in one flight, at a constant height of not more than 20 feet. The speed of each of the four flights will be taken and the average of the four speeds will constitute the performance.

Competitors will be at liberty to take off from any point on the aerodrome. They must enter the Low Speed Course within five minutes of their starting time. On completing the course after each of the first three flights the Competitors must turn and immediately re-enter the course. On completing the test the Competitors must land, so as not to interfere with other tests. The Stewards will be the sole judges as to whether time has been unnecessarily wasted between the

flights on the course, and may rule that no marks be awarded.

Range of Speed

No marks will be awarded unless the aeroplane satisfies both the following conditions:

High Speed . . . Not less than 60 M.P.H.

Low Speed . . . Not more than 45 M.P.H.

Marks will be awarded for Range of Speed expressed as a percentage of the Low Speed, e.g.:

High Speed is . . . . . . 60 M.P.H.

Low Speed is . . . . . . 40 M.P.H.

Range of Speed is . . . 20 M.P.H.

Percentage, Range of Speed/Low Speed = 50%.

The basis of marking to be:-

No marks for a percentage of 33 1/3% or less.

Eight marks for every 1% over 33 1/3%, and parts of 1% pro rata.

Getting Off

This test will consist of a take off, starting from rest and flying in a straight line over a barrier 25 feet high.

The pilot will select his own distance from the barrier.

Marks will be awarded according to the distance from the starting point to the barrier, on the following basis:

One mark for every yard by which the distance is less than 450 yards.

The wheels of the aeroplane will be placed on the line of start selected by the Competitor. The start will be a standing one. No assistance, launching devices or chocks will be permitted for the ac-

tual getting off.

Competitors must land immediately after the attempt.

Pulling Up

This test will consist of a straight landing over a barrier 6 feet high.

Marks will be awarded according to the distance from the barrier at which the aeroplane comes to rest, on the following basis:

> One mark for every yard by which the distance from the center of the barrier is less than 150 yards.

The engine may be shut off before crossing the barrier.

Any form of braking device may be used provided it is carried throughout the Competitions.

The distance will be measured from the center of the barrier in a straight line to the furthest point of contact of the aeroplane with the ground. Only normal straight landings will be measured. In the event of damage to the aeroplane which in the opinion of the Stewards would prevent further flight, no marks will be awarded.

Low Speed, Getting Off, and Pulling Up Tests

The Stewards will decide from day to day the time allotted for the above tests. Their decision will be announced on the Official Notice Board at 9.30 a.m. each day, together with the order and time of starting.

All Competitors will be allowed the same number of attempts, but any Competitor failing to start within five minutes of his starting time will not be allowed to start, and the attempt will count against him.

Photostat "as is"
Leave for binding

TABLE I.

TRIALS AT LYMPNE, 1923 (SINGLE SEATERS).

			Power Unit.			Loading.				Aerodynamic Features.							Performance.				
Contractor.	Aircraft.	Type.	Engine.	H.P. at R.P.M.	Prop. Drive.	Lbs. Wt. Empty.	Lbs. Wt. Loaded.	Lbs./H.P.	Lbs./sq. ft	Length Overall.	Ht. on Ground.	Span.	Mean Chord.	Area sq. ft.	Aerofoil Section.	Aspect Ratio.	Speed Range M.P.H.	Top Speed M.P.H. Trials.	Economy M.P. Gall.	Endurance Miles.	Altitude Feet.
Air Navigation and Eng. Co.	A.N.E.C.	Braced High Wing Monoplane	694 c.c Blackburne	26 at 3800 15 at 2500	Direct	290	470	18.1 31.3	3.24	15′ 7″	4′ 9″	32′ 10″	4′ 5″	145	Thick dev. by designer	7.44	32-80	74	87.5	775	14,400
A. V. Roe and Co.	Avro Type 558	Biplane	500 c.c. Douglas	17 at 4000	Chain 2½ to 1	298	483	28.4	2.91	19′ 8½″	6′ 9″	30′ 0″	3′ 0″	166	R.A.F. 15	10.44	30-60	—	—	50	13,850
A. V. Roe and Co.	Avro Type 560	Cantilever High Wing Monoplane	694 c.c. Blackburne	15 at 2500	Direct	286	471	31.4	4.28	21′ 0″	4′ 9″	30′ 6″	4′ 1″	110	Thick dev. by designer	8.86	34-65	—	63.3	1000	—
De Havilland Aircraft Co.	D.H. 53	Braced Low Wing Monoplane	750 c.c. Douglas	15 at 2500	Direct	310	490	32.7	4.08	19′ 8½″	5′ 0″	30′ 1″	4′ 3″	120	Thickened R.A.F. 15 varying thickness	7.08	36-65	57.5	59.3	375	—
Gloucestershire Aircraft Co.	Gannet	Biplane	750 c.c Carden (2-stroke)	13 at 2200	Direct	248	440	33.9	4.07	16′ 8″	6′ 0″	18′ 0″	3′ 1½″	108	Thickened No. 64	5.98	Engine trouble prevented flying.				
Short Bros.	Gull	Braced High Wing Monoplane	694 c.c. Blackburne	26 at 3800	Chain 1.61 to 1 2-pusher airscrew	360	540	20.75	3.29	20′ 10″	4′ 4″	36′ 2″	5′ 0″	164	Approx. R.A.F. 14 with step dev. by designer	7.92	38-65	69.0 M'sham. 55.25	—	37.5	—
Air Navigation and Eng. Co.	Handasyde	Braced High Wing Monoplane	750 c.c. Douglas	15 at 2500	Direct	300	500	33.4	3.7	19′ 2″	4′ 3″	30′ 0″	4′ 11″	135	Göttingen 422	6.2	30-65	—	65.7	158.5	—
Handley Page	H.P.	Cantilever High Wing Monoplane	400 c.c. A.B.C.	8 at 3000	Direct	274	450	56.3	2.84	21′ 3″	4′ 2″	36′ 6″	4′ 3″	158	No. 64 increased to 12% camber	7.2	25-30	—	—	37.5	—
R.A.E. Aero Club	Hurricane	Cantilever High Wing Monoplane	600 c.c. Douglas	20¼ at 4000	Chain about 2 to 1	375	564	27.5	7.05	16′ 0″	4′ 7″	23′ 0″	3′ 9¾″	80	Göttingen 420 Rev. 398 436 428 Tip.	6.04	42-75	58.5	—	25.0	—
L. Peyret	Peyret	Braced High Wing Monoplane	750 c.c. Sergant	15 at 3200	Single helical spur gear 2½ to 1	330	515	34.4	3.14	18′ 3″	5′ 6″	32′ 4″	4′ 9″	164	Unknown thick section	6.4	28-65	—	—	—	9,400
Geo. Parnall and Co., Ltd.	Pixie I.	Braced Low Wing Monoplane	500 c.c. Douglas	13 at 3000	Chain 2 to 1	276	457	35.1	4.57	18′ 0″	4′ 8″	29′ 0″	4′ 2″	100	R. & M. 322 varying thickness	6.22	36-65	—	53.4	125	—
Geo. Parnall and Co., Ltd.	Pixie II.	Braced Low Wing Monoplane	750 c.c. Douglas	26 at 5000	Chain 2 to 1	279	460	17.7	7.67	18′ 0″	4′ 9″	17′ 10″	4′ 7″ max.	60	R. & M. 322 varying thickness	3.9	45-90	76.1	—	—	—
—	Poncelet	Cantilever High Wing Monoplane	750 c.c. Sergant	15 at 3200	Single helical spur gear 2½ to 1	490 425	690 625	46.0 41.6	2.80 2.98	21′ 6″ 21′ 6″	— —	— 36′ 6″	— —	247 210	Fokker type	— —	32-65 —	— —	— —	— 75	— —
Vickers, Ltd.	Viget	Biplane	750 c.c. Douglas	19 at 3400	Chain 3 to 1	390	570	30.0	2.85	17′ 4″	7′ 1″	25′ 0″	4′ 3″	200	R.A.F. 15	6.01	30-65	58.1	—	50	—
English Electric Co., Ltd.	Wren	Cantilever High Wing Monoplane	398 c.c. A.B.C.	7 at 2500	Direct	232	420	60.0	2.90	24′ 3″	4′ 6″	37′ 0″	3′ 11¼″	145	T. 64 varied	9.37	25-49	49.0 M'sham. —	87.5	362.5	—

The Stewards may allow additional attempts in the same order, as time permits.

Table II.

Trials at Lympne, 1923, (Single Seaters).

Firm	Aircraft	Mono or biplane	Weight of Components as % of Total All-up Wt. Total wings	Total tail	Total body	Total structure	Total power unit	Total load unit
Air Nav. Co.	A.N.E.C. I.	M	30.0	2.7	14.3	47.0	21.9	31.1
A. V. Roe	Type 558	B	19.1	3.1	18.6	40.8	24.4	34.8
A. V. Roe	Type 560	M	19.7	3.0	18.7	41.4	22.9	35.7
De Haviland	D.H. 53	M	20.0	4.0	22.6	46.6	16.7	36.7
Gloucester	Gannet	B	16.8	2.5	23.3	42.6	17.4	40.0
Short Bros.	Gull	M	24.8	3.4	18.1	46.3	24.0	29.7
Handley Page	H.P.	M	29.8	4.0	17.1	50.9	11.1	37.3
R.A.E. Club	Hurricane	M	21.0	3.6	14.9	39.5	27.5	33.0
Parnall	Pixie I	M	14.0	3.5	17.3	34.8	27.1	38.1
Parnall	Pixie II	M	14.6	3.5	17.2	35.3	26.9	37.8
Vickers	Viget	B	21.6	3.6	18.5	43.7	25.4	30.9
Eng. Elec.	Wren	M	24.7	4.8	19.6	49.1	12.5	38.4

Trials at Lympne, 1924, (Two-Seaters).

Weight of Components as % of Total All-up Wt.

Firm	Aircraft	Mono or biplane	Total wings	Total tail	Total body	Total structure	Total power unit	Total load unit
Bristol	Brownie	M	21.8	2.1	20.7	44.6	15.7	39.7
Cranwell	Cranwell	B	19.6	4.0	19.8	43.4	16.5	39.1
Beardmore	Wee Bee	M	20.9	2.4	21.3	44.6	15.9	39.5
Westland	Wood Pigeon	B	18.1	2.7	20.0	40.8	16.0	43.2
Westland	Widgeon	M	15.6	2.6	29.8	48.0	14.1	37.9
Air Nav.Co.	A.N.E.C. II	M	20.6	2.9	17.5	41.0	18.2	40.8
Short Bros.	Satellite	M	21.7	3.4	26.2	51.3	13.4	35.3
Supermarine	Sparrow	B	23.1	3.1	14.6	40.8	19.9	39.3
A. V. Roe	Avis	B	19.2	2.4	27.1	48.7	14.4	36.9
Blackburn	Blue Bird	B						
Hawker	Cygnet I	B	16.5	3.2	12.8	32.5	20.5	47.0
Hawker	Cygnet II	B	16.8	3.3	13.1	33.2	18.6	48.2
Vickers	Vagabond	B	20.8	2.7	20.0	43.5	17.5	39.0
Parnall	Pixie III	M	18.3	3.8	16.5	38.6	19.0	42.4
Parnall	Pixie IIIa	B	23.8	3.5	15.4	42.7	17.8	39.5
Bristol	Bristol Fighter F.28	B	13.3	1.85	12.2	27.35	45.1	27.55

Photostat "as is"
Leave for binding

TABLE III.

TRIALS AT LYMPNE, 1924 (TWO-SEATERS).

			Power Unit.			Loading.				Aerodynamic Features.							Performance.						Reliability.	
Contractor.	Aircraft.	Type.	Engine.	H.P. at R.P.M.	Prop. Drive.	Lbs Wt. Empty.	Lbs. Wt. Loaded.	Lbs./H.P.	Lbs./sq. ft.	Length Overall.	Height on Ground.	Span.	Mean Chord.	Area sq. ft.	Aerofoil Section.	Aspect Ratio.	High Speed for ten laps M.P.H.	High Speed for one lap M.P.H.	Low Speed M.P.H.	Speed Range M.P.H.	"Take Off" over 25ft. Yards.	Landing Run over 6ft. Barrier. Yards	Hours Flown.	Miles Flown.
Bristol Aircraft Co.	Brownie I.	Cantilever Low Wing Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	500	862	26.8 33.9	4.23	26′ 3″	6′ 6″	36′ 7″	6′ 0″	204	Based on R.A.F. 15	6.0	65.19	— 66.02	38.73	26.46 27.29	215	102.6	10.375	512.5
Bristol Aircraft Co.	Brownie II.	Cantilever Low Wing Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	500	873	27.2 34.3	4.55	26′ 3″	6′ 6″	34′ 7″	6′ 0″	192	Based on R.A.F. 15	6.0	—	—	—	—	—	—	—	—
Cranwell Aero Club	Cranwell	Biplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	515	980	30.5 38.5	3.78	23′ 6″	7′ 8″	29′ 8″T 22′ 8″B	5′ 0″T 4′ 0″B	259	No. 64	5.36	—	—	—	—	—	99.4	17.889	762.5
W. Beardmore and Co., Ltd.	Wee Bee	Braced High Wing Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	462	837	26.0 32.8	4.01	22′ 2″	5′ 6″	38′ 0″	5′ 0″	208.5	Shackleton .0732 camber	7.6	70.11	— 79.37	39.66	30.45 39.71	235	124	11.912	737.5
Westland Aircraft Works	Wood Pigeon	Biplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	440	780	24.2 30.6	3.88	19′ 6″	7′ 0″	22′ 9″ 22′ 9″	3′ 8″ 3′ 8″	201.5	No. 64	6.15	—	— 58.96	—	—	—	—	2.528	125
Westland Aircraft Works	Widgeon	Parasol Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	475	896	27.8 35.1	4.81	21′ 0″	6′ 11″	30′ 8″	4′ 9″	186.4	Airscrew No. 4, R. & M. 322	6.46	—	—	—	—	—	—	—	—
Air Navigation and Eng. Co.	A.N.E.C. II.	Braced High Wing Monoplane	1100 c.c. V-twin inverted Anzani	31 at 3000	Direct	460	830	26.8	3.95	20′ 8″	6′ 8″	38′ 0″	5′ 0″	210	Shackleton .0732 camber	7.6	—	—	—	—	—	—	—	—
Short Bros.	Satellite	Normal Cantilever Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	640	1014	31.5 39.8	4.82	23′ 9″	5′ 6″	34′ 0″	5′ 6″	211	R.A.F. 15 to Glenmartin 4	6.2	—	—	—	—	—	—	—	—
Supermarine Aviation Works	Sparrow	Biplane	1100 c.c. radial Blackburn	32 at 3000 27 at 2700	Direct	531	905	28.3 33.5	2.87	23′ 0″	7′ 3″	33′ 6″T 27′ 6″B	5′ 8″T 3′ 6″B	316	Sloane (top), A.D.I. (bottom)	7.4	—	—	—	—	—	—	—	—
A. V. Roe and Co.	Avis	Biplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Geared 2 to 1	550	920	28.6 36.1	2.79	24′ 0″	9′ 0″	30′ 0″T 30′ 0″B	4′ 6″T 4′ 6″B	330	No. 64	6.7	—	—	—	—	—	—	—	—
Blackburn Aeroplane and Motor Co.	Bluebird	Biplane	1100 c.c. radial Blackburn	32 at 3000 27 at 2700	Direct	500	875	27.3 32.4	3.07	21′ 8″	7′ 10½″	28′ 0″T 28′ 0″B	4′ 9″T 4′ 9″B	284.6	—	—	—	—	—	—	—	—	—	—
Hawker Eng. Co.	Cygnet I.	Biplane	1100 c.c. Anzani	35 at 3600 31 at 3000	Direct	380	750	21.4 24.2	3.52	20′ 5″	6′ 6″	28′ 0″T 23′ 0″B	4′ 3″T 2′ 6″B	213.2	M/80 Loening	5.15	—	— 71.23	43.95	— 27.28	269	66.7	8.382	400
Hawker Eng. Co.	Cygnet II.	Biplane	1100 c.c. A.B.C. Scorpion	35 at 3600 31 at 3000	Direct	385	755	21.6 24.4	3.55	20′ 5″	6′ 6″	28′ 0″T 23′ 0″B	4′ 3″T 2′ 6″B	213.2	M/80 Loening	5.15	—	— 71.31	37.42	— 33.89	250	72.66	10.4123	475.0
Vickers	Vagabond	Biplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Geared 2 to 1	428	887	27.6 34.8	3.15	22′ 0″	7′ 10″	28′ 0″B 28′ 0″T	4′ 6″B 4′ 6″T	282	R.A.F. 15	6.22	—	—	—	—	—	—	—	—
Geo. Parnall and Co.	Pixie III.	Braced Low Wing Monoplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	463	831	25.8 32.6	5.15	21′ 3″	6′ 0″	32′ 5″	2′ 11½″	161.5	R. & M. 322, Airscrew 1-4	7.0	—	—	—	—	—	—	—	—
Geo. Parnall and Co.	Pixie III.a	Biplane	1100 c.c. Cherub	32.2 at 3200 25.5 at 2500	Direct	523	891	27.7 35.0	3.4	21′ 3″	6′ 3″	25′ 8″T 32′ 5″B	2′ 11½″	262.5	R. & M. 322, Airscrew 1-4 bottom 8	7.0 7.3	—	—	—	—	—	—	—	—
Geo. Parnall and Co.	Pixie III.a	Biplane	1100 c.c. radial Blackburn	32 at 3000 27 at 2700	Geared	552	920	28.7 34.1	3.5	21′ 3″	6′ 3″	25′ 8″T 32′ 5″B	2′ 11½″	262.5	Top plane unknown	7.0 7.3	—	— 59.84	37.22	— 22.62	301	70	10.764	450

Table IV.

Air Ministry Commercial Air Trials.

Martlesham, 1920.

	Firm	Aircraft	Engine HP	Getting Off Yards Run	Getting Off Height in ft.	Landing Height in ft.	Landing Yards Run
Large Aeroplanes	Handley Page	W.8	2x450	275	74.1	50	363
	Vickers	Vimy Commercial	2x350	275	26.45	50	308
	Central Aircraft Co.	Centaur	2x160	275	0	50	281
Small Aeroplanes	Austin Motor Co.	Kestrel	160	175	13.18	50	244
	Bristol Aero. Co.	230 Siddeley 230 Puma Siddeley	230	175	19.27	50	313.5
	Westlands	6-Seater	450	175	22.75	50	235
	A. V. Roe	Triplane	230	175	1.18	50	239.1
	Sopwith Aviation	Antelope	200	175	23.0	50	187.7

Table V.

Summary of Air Meter Readings taken at Lympne Aerodrome

During the Light Aeroplane Trials, 9-29-24 - 10-4-34.

Date	Time of Observation	Direction	Speed M.P.H.
9-29-24	10.00	S.	16.4
"	10.03	S.	15.4.
10-1-24	9.30	S.E.	4.6
"	9.35	S.E.	5.8
"	11.21	S.E.	9.3
"	11.24	S.E.	8.3
"	11.50	S.S.E.	9.3
"	11.53	S.E.	8.9
"	12.13	S.S.W.	9.2
"	12.15	S.W.	9.3
"	14.59	S.	8.8
"	15.02	S.W.	9.4
"	16.01	S.S.W.	7.3
"	16.03	S.	6.6.
"	16.37	S.	6.4
"	16.41	S.W.	5.6
"	17.34	S.W.	4.4.
"	17.40	S.W.	4.6.
10-2-24	9.15	N.W.	1.5
"	9.18	N.W.	3.1
"	10.07	W.N.W.	5.3

Table V (Cont.)

Summary of Air Meter Readings Taken at Lympne Aerodrome

During the Light Aeroplane Trials, 9-29-24 - 10-4-24.

Date	Time of Observation	Direction	Speed M.P.H.
10-2-24	10.10	W.N.	5.3
"	10.44	W.N.W.	2.9
"	10.48	W.	1.6
"	11.43	S.S.W.	4.0
"	11.47	S.W.S.	3.3
"	12.30	S.E.	4.3
"	12.33	S.E.	5.2
"	13.15	S.S.E.	4.6
"	13.18	S.E.S.	5.2
"	16.43	W.N.	3.6
"	16.47	W.N.W.	4.1
10-3-24	8.48	E.	5.1
"	8.52	E.S.E.	3.4
"	9.48	S.S.E.	8.5
"	9.51	S.E.	8.2
"	11.10	S.S.E.	6.8
"	11.13	S.S.E.	6.8
"	11.49	S.S.E.	7.1
"	11.52	S.S.E.	7.2
"	12.31	S.E.	9.8
"	12.34	S.E.	9.2

Table V (Cont.)

Summary of Air Meter Readings Taken at Lympne Aerodrome

During the Light Aeroplane Trials, 9-29-24 - 10-4-24.

Date	Time of Observation	Direction	Speed M.P.H.
10-3-24	13.45	S.E.	7.0
"	13.48	S.E.	5.8
"	14.41	S.E.S.	7.5
"	14.44	S.E.	7.2
"	15.55	S.E.	4.6
"	15.58	S.E.	5.0
"	17.30	E.	2.9
"	17.33	E.	2.0
10-4-24	9.02	E.S.E.	5.0
"	9.05	S.E.	5.3
"	9.57	S.S.E.	7.3
"	10.00	S.E.S.	6.2
"	10.31	S.E.S.	3.9
"	10.34	S.E.	4.7
"	10.55	S.S.E.	4.3
"	10.58	S.	4.9
"	11.10	S.E.	4.0
"	11.13	S.	3.7